Tokamak GOLEM for fusion education – chapter 16: Bayesian discharge optimization, Artificial Neural Network tomography, runaway electrons, lithium evaporator, impurities

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This contribution is devoted to current student's projects at the GOLEM tokamak at the Czech Technical University in Prague in support of the Institute of Plasma Physics (IPP CAS). This device is the oldest operational tokamak in the world and is focused on the education of future fusion specialists. Uniquely, GOLEM tokamak features a full remote-control system which extends its reach worldwide. This is the second part of two contributions on this subject.

The **first test of the Golem tokamak discharge optimization using direct algorithmic control** of the device was conducted. With 4 discharge control parameters, the **Bayesian optimizer found optimal conditions for the longest discharge** with the given configuration and wall conditions within 30 iterations. The algorithm successfully controlled the machine for a full experimental session in the quest to reach the longest possible discharge. Training dataset optimization is being studied to enhance the performance of an **Artificial Neural Network (ANN)-based tomographic reconstruction of visible plasma radiation distribution** at the GOLEM tokamak. The **Timepix3 pixel detector** is being evaluated for its ability to **characterize X-ray emissions from runaway electrons (REs)**. Multiple scintillation probes, combined with Geant4 modeling, help infer RE properties from indirect HXR observations. Additionally, **in-vessel scintillation probe is being developed to enable direct RE detection**, offering more precise measurements. A **Lithium evaporator is currently being developed** to be used as an **impurity source for transport studies**. In the future, it could also be used as a lithium source for wall conditioning purposes. A remote experimental campaign was conducted from PUC-Chile, employing **2 ms spectrometry to evaluate wall conditioning and impurity effects** on hydrogen and helium plasma performance in GOLEM, through the time-resolved monitoring of emission lines. An **upgraded diamagnetic ring** was also installed into the tokamak.